REMARKS

Applicants have carefully considered this Application in connection with the Examiner's Final Office Action of August 10, 2006, and respectfully request reconsideration of this Application in view of the above amendment and the following remarks.

Applicants wish to thank the Examiner for granting a telephonic interview on February 2, 2007, in which meaning exchanges were made.

Applicants have cancelled Claims 29-57, 64, 69, and 70. Applicants have amended Claim 1 to provide that the three-dimensional model is complete and is as an output readable and editable in a 3-D computer-aided-design ("CAD") software system. Support for this amendment can be found in the specification at Paragraph 53, figure 1a, boxes 34, 18 and 20, and in Figure 3a, in particular box 129, which show that the 2-D drawings are analyzed to produce a list of features written to an intermediate UFO file that is then interfaced with a CAD system to produce a full, true, and "**complete**" parametic feature-based 3-D model. Applicants have amended Claims 1 and 58 to provide that the steps of "ordering" and "producing an ordered list" are performed using 2-D geometry of up to six orthographic views. Support for this amendment can be found in the specification at Paragraphs 59, 64, 65, and 74, which all discuss the use of more than one orthographic view. The definition of "features library" given on Page 40 also includes the explanation that the library contains "a class to contain the original two-dimensional drawing split into orthographic views." Claims 1, 6, 20, 22, 24, 26, and 58 have also been amended to provide that the binary file is an intermediate binary file. Support for this amendment can be found in the specification at Paragraph 25, in which an example of an intermediate Universal Feature Object ("UFO") is described as being in a binary file format. Applicants have also amended Claims 65 and 72 to clarify the claim language.

Pending claims in the Application are: Claims 1, 6-13, 19-22, 24, 26, 28, 58-63, 64-68, 71 and 72.

I. Drawings

Applicants wish to thank the Examiner for withdrawing the objections to the drawings.

II. Claim Objections

Applicants wish to thank the Examiner for withdrawing the objections to the claims.

III. Election/Restrictions

Applicants have cancelled Claims 29-57, 64, 69, and 70 in accordance with the Examiner's instructions.

IV. Rejections Under 35 U.S.C. §112, Second Paragraph

Claims 65 and 72 stand rejected pursuant to 35 U.S.C. §112, second paragraph, as being indefinite. The Examiner has indicated that it is unclear which of the limitations in these claims pertain to steps (a), (b), (d), and (e). Applicants have amended Claims 65 and 72 above to clarify which of the listed claim limitations pertain to steps (a) and (b) in Claim 65 and steps (d) and (e) in Claim 72.

In the Advisory Action dated January 9, 2007, the Examiner indicated that these amendments to Claims 65 and 72 would overcome the §112, second paragraph, rejections if the amendments were entered. In view of the filing of this RCE and the entering of the amendments, Applicants respectfully request that these rejections be withdrawn.

V. Rejections Under 35 U.S.C. §103(a)

A. NPL Document By Balachander

Claims 1, 6-13, 19-22, 24, 26, and 28 stand rejected under 35 U.S.C. §103(a) as being unpatentable over the NPL Document "Form Feature Extraction from 2-D Orthographic Views" by Balachander ("Balachander"). The Examiner asserts that Balachander teaches all of the limitations of these claims. Applicants respectfully disagree. Claim 1 has been amended to provide that (1) the three-dimensional model is complete and is output readable and editable in a 3-D computer-aided-

design ("CAD") software system, (2) the "ordering the plurality of built features" is done using 2-D geometry of up to six orthographic views of the built features, and (3) the representation is stored in an intermediate binary file format.

As was discussed during the telephonic interview held on February 2, 2007, the first named inventor, Professor V. Devarajan, of this application was the thesis advisor for Balanchander. The cited Balanchander reference is a master thesis completed under the direction of Professor Devarajan. Balanchander does not teach the building of features, no 3-D features were built.

1. Balachander does not teach the 3-D features required to carry out the steps of the claimed subject matter

Applicant maintains that Balachander bases his theory of identifying features on simple and generic 3-D shaped elements such as cones, spheres and parallelopipeds. These simple and generic shapes are not among the set of 3-D design features used in mechanical CAD technology. The claims require that the **complete** three-dimensional model be output readable and editable in a CAD software system. The claimed subject matter utilizes generic as well as specific 3-D features listed in any mechanical CAD software. Figures in Balanchander, such as figures 5.23 and 6.5, simply show one view of a 3-D model or a 2-D isometric view of a 3-D model. Nowhere in Balanchander is a teaching of building a **complete** 3-D model. Appendix III of Balanchander provides only 2-D information, no 3-D information can be found. The fact that Balachander was published in 1994 remains important because the claims require that the 3-D model be output readable and editable in a CAD software system. Balachander's simple and generic 3-D shape elements are not among the set of 3-D design features that a person of ordinary skill in the art, while inventing the subject matter of the current claims during the relevant period of time, would even begin to consider.

2. Balachander does not teach the storage of feature data required to carry out the steps of the claimed subject matter

Furthermore, Balachander does not teach the storage of feature data (related to the 3-D domain) in the model. A study of the "feature database" mentioned in Section 5.4.5, pages 54-56, of Balachander clearly shows that it does not store any data pertaining to the features in the 3-D domain other than elementary parameters such as height, length and depth of the generic shapes. There is no

discussion of the means to use these parameters to create a 3-D model on a computer, which the current claims clearly pertain to. The underlying requirement for this is to store or base the feature data based on a reference 3-D coordinate system, which is supported in the claimed subject matter. No information on the 3-D plane/coordinate system is present in the output format of the data file in Balachander.

3. Balachander does not teach the step of ordering the features

Applicants also maintain that Balachander does not teach or suggest the step of ordering the features identified. The Examiner contends that Balachander teaches the resolution of feature order at Page 9 and an intermediate file for storing output at Page 63. These sections do not remotely teach the claimed subject matter of feature ordering. The ordering of features described in Balachander simply does not teach the broad scope of the term ordering as it is used in the current claims. The cited portion of Balachander discusses a taxonomy of features, prevalent during the time of the publication. Page 9 of Balachander deals with the taxonomy or classification of feature semantics which was prevalent in mechanical CAD references a the time of the publication but have no bearing whatsoever on the process of ordering of individual 3-D features in a 3-D model as would be understood by a person of ordinary skill in the art at the time the current claimed subject matter was invented. In addition, Page 63 of Balachander has no bearing on storing the 3-D model representation in an intermediate format. Appendix III of Balachander refers to the output file generated from Balachander's pseudocode. A close look at the output files show that only loop coordinates from the input drawing (Refer also to Appendix II – input files) have been stored. They do not conform remotely to 3-D feature data. The term "intermediate file" in the applicant's invention (as further described in Claims 22, 24) refers to the creation of a data representation format just prior to entering the parent CAD environment and just prior to creating the model in the parent CAD document. It has also been referred to as being in binary file format (in Claims 1, 6, 20, 26 and 58).

Thus, the term "ordering" as it is used in the claims clearly pertains to the completely resolved order of individual 3-D features required while building the 3-D model, and the claims refer to the process of transfer of model data based on this ordering. Balachander does not teach or

suggest resolution of feature order. As a result of the absence of feature ordering, Balachander cannot and does not describe any process of building the three-dimensional model from the identified features. The ordering of features and the building of the three-dimensional model are required in Claim 1.

4. Balachander does not teach feature constraints as this term is used in the claims

The term "constraints" used in Balachander also does not convey a teaching that is sufficient to render the claimed subject matter obvious. The Examiner contends that Balachander teaches the term "constraint" at Page 18 and Figure 4.1. However, Balachander uses this term generically and includes no teachings relevant to the claims. In Balachander, the term refers to the parametric definition of a generic shape in 2-D views. In Figure 4.1, Balachander illustrates the definition of a cone. In the current claims, the term "feature constraints" refers to the binding that one 3-D feature may have with other features, which depends on or directly influences the process of 3-D model creation. This subject matter is described in Claim 19, as well as in Appendix A, at the bottom of Page 43.

Claims 6-13, 19-22, 24, 26, and 28, due to their dependence on Claim 1, are patentable over Balachander for the reasons discussed above.

5. Balachander does not teach the geometry library and feature library claimed in Claims 6 and 7

With regard to the rejections of Claims 6-7, the sections of Balachander cited by the Examiner are not extensive enough to teach the entirety of the subject matter of Claims 6 and 7. Much of the form feature information in Balachander is essentially still stored in 2-D loop stages. In the current claims, full-fledged object-oriented libraries exist that describe in its entirety the three-dimensional model, including the 2-D feature profile, the 3-D plane and coordinate system information on which the feature is built and its extent. In order to make the 3-D model output readable and editable in a CAD software system, as the claims require, these libraries must be much more extensive.

6. Balachander does not teach the application of object-oriented relationship between individual dependent feature date as claimed in Claims 8-10

With regard to the rejections of Claims 8-10, these claims describe the process of applying object-oriented relationships between the individual dependent feature data. The Examiner has rejected these claims by citing teachings in Balachander that do not teach or suggest the claimed subject matter. First of all, the code in Balachander was implemented using C (see Page 61 of Balachander). A study of the pseudo code on Pages 74-75 of Balachander clearly shows the absence of any evidence of storing the 3-D feature data in object-oriented data structures. Further, a study of the Find_Loop hierrarchy module reveals the fact that the feature loops are not ordered using the information from all the orthographic views together but in fact, only for the current view. Also, no information can be deduced about feature ordering resolutions in the event that multiple parent loops exist for a particular feature loop.

7. Balachander does not teach the feature extraction that is required to carry out the steps of Claims 11-13

With regard to the rejections of Claims 11-13, the context of the term "planes" in the cited sections of Balachander (i.e., "**extraction of feature whose axes are either parallel or perpendicular to one of the three principal planes**") is not the same as that in the rejected claims. This section of Balachander only refers to the limitation in the feature identification process. Features located on a plane other than the principal axes could not be identified. Despite the Examiner's assertions, Balachander does not teach or suggest feature extraction in such a way as to render the claimed subject matter obvious. The Examiner has cited to figures 5.22 and 5.23 of Balachander. These figures crudely discuss an algorithm to determine the protrusion/depression nature of the generic shape and do not show any means to store the elevation off of a 3-D reference plane required to create a feature. Thus, Balachander does not teach all of the steps of feature extraction that are required by the current claims.

As mentioned earlier, the features identified in Balachander do not store any information related to their positioning in the 3-D Plane system and as a result cannot be built in 3-D space. Although the Examiner mentions "these features have an elevation from a given world

origin...ground from which the 3-D shape rests on" in the explanation of the rejection, Balachander does not store the same "elevation" data that is essential for future creation in a 3-D model. Claims 11-13 require this capability.

8. Balachander does not teach the claimed "feature constraints" of Claim 19

The Examiner contends that Balachander teaches the term "constraint" at Page 18 and Figure 4.1. However, Balachander uses this term generically and includes no teachings relevant to the claims. In Balachander, the term refers to the parametric definition of a generic shape in 2-D views. In Figure 4.1, Balachander illustrates the definition of a cone. In the current claims, the term "feature constraints" refers to the binding that one 3-D feature may have with other features, which depends on or directly influences the process of 3-D model creation. The distinguishing factor is that the constraints in the claimed process are created to capture the designer's intent behind the geometry whereas the corresponding sections in Balachander refer merely to the correct creation of the geometry.

9. Balachander does not teach storing 2-D input views in an intermediate binary file format as in Claims 20-21

With regard to Claims 20-21, these claims require the capability of the input two-dimensional view to be stored along with the three-dimensional model in the binary file format. The motive behind this capability is to provide subsequent 3-D model verification. This is not what is taught in Balachander when it states "The coordinates of the start and end points...are normalized with respect to a common origin" on page 26. This page discusses the process of customizing the input drawing prior to the process of feature extraction. Balachander does not provide any discussion about providing model verification capability.

10. Balachander does not teach the ordering of the features claimed in Claims 22 and 24

The Examiner contends that Balachander teaches the resolution of feature order at Page 9 and an intermediate file for storing output at Page 63. These sections do not remotely teach the claimed subject matter of feature ordering. The ordering of features described in Balachander simply does

not teach the broad scope of the term ordering as it is used in the current claims. The cited portion of Balachander discusses a taxonomy of features, prevalent during the time of the publication. Page 9 of Balachander deals with the taxonomy or classification of feature semantics which was prevalent in mechanical CAD references a the time of the publication but have no bearing whatsoever on the process of ordering of individual 3-D features in a 3-D model as would be understood by a person of ordinary skill in the art at the time the current claimed subject matter was invented. In addition, Page 63 of Balachander has no bearing on storing the 3-D model representation in an intermediate format. Appendix III of Balachander refers to the output file generated from Balachander's pseudocode. A close look at the output files show that only loop coordinates from the input drawing (Refer also to Appendix II – input files) have been stored. They do not conform remotely to 3-D feature data. The term "intermediate file" in the applicant's invention (as further described in Claims 22, 24) refers to the creation of a data representation format just prior to entering the parent CAD environment and just prior to creating the model in the parent CAD document.

11. Balachander does not teach the "serially defined object data structures" of Claim 26

With regard to the rejection of Claim 26, there is no teaching or suggestion of "serially defined object data structures" on Page 56 of Balachander. As mentioned earlier, Balachander discusses the identification of only the simple parameters (height, length, depth, etc.) of the generic feature shapes and does not discuss storing the coordinate system information necessary for the building of the features in the 3-D model. The Examiner asserts that Balachander suggests the features being built according to a common coordinate system at Page 56. This is not true, as the figure on the top of Page 56 refers only to the classification or description of features with its trivial geometric parameters – height, length, depth, etc., and their functional types. They bear no relevance whatsoever to their positioning with respect to a common coordinate system.

12. Balachander does not teach updating the binary file format as required by Claim 28

Finally, with regard to Claim 28, the section of the text on page 33 of Balachander cited by the Examiner refers to the discussion of modifying input drawings to contain hidden lines prior to

the process of the extraction of isolated features. This is entirely different in context than the term "updated" in the text "binary file format can be incrementally updated" of Claim 28. The claim term refers to the ability to incrementally update the binary file format containing the finished 3-D model after any changes have been made to it in the target CAD system.

Considering all of the above differences, it cannot be argued that Balachander teaches the subject matter of the amended claims or any other dependent claims of the current application. Balachander does not disclose feature ordering through the use of up to six orthographic views of the features, which Claim 1 requires. Balachander does not teach that the 3-D model is output readable and editable in a computer-aided-design software system, as Claim 1 requires. A person of ordinary skill in the art, reading the claims in the context of the specification, would understand that Balachander did not teach such subject matter. The piecemeal, out of context statements from Balachander cited by the Examiner do not amount to the teachings needed to render the claimed subject matter obvious. In fact, most of the cited excerpts from Balachander do not stand for a proposition even remotely close to that recited in the claims. In view of the great differences between Balachander and the claims, and Balachander's complete failure to teach or suggest the claim limitations, Claims 1, 6-13, 19-22, 24, 26, and 28 are not anticipated by Balachander.

B. Balachander in view of U.S. Patent 6,212,441 to Hazama

Claims 58-63, 65-68, and 71-72 stand rejected under 35 U.S.C. §103(a), as being unpatentable over Balachander in view of U.S. Patent No. 6,212,441 to Hazama et al. ("Hazama"). The Examiner asserts that Hazama teaches the claim limitations that are not explicitly taught by Balachander and that the references in combination render the above claims obvious. Applicants respectfully disagree. Claim 58 has been amended to require that the step of "producing an ordered list of three-dimensional features" is done using 2-D geometry of up to six orthographic views of the three-dimensional features.

Claims 59-63, 65-68, and 71-72 depend from Claim 58. Applicants respectfully assert that neither Balachander, nor Hazama, nor Balachander in view of Hazama teaches the limitations of

Claim 58. Thus, the dependent claims are not rendered obvious. Furthermore, Hazama does not teach the limitations that are explicitly noted by the Examiner as being absent from Balachander.

1. Balachander does not teach performing a profile analysis or producing an ordered list of features, as required by Claim 58

First, with regard to Claim 58, the Examiner's argument that item (d) of the claim "performing a profile analysis and feature analysis on the matched feature loops" has been taught by Balachander is incorrect. The text sections on page 18 and 19 of Balachander merely refer to the identification of simple, stand-alone geometric shapes and bear no relevance to the process of performing an analysis of the matched feature loops (which is required by Claim 58) to resolve the dependencies in the ordering of the individual features. Balachander also does not provide any teachings on "producing an ordered list of three-dimensional features" (item (e) of Claim 58) based on which the 3-D model can be built. The step of "consider[ing] the feature loops" identified by the Examiner on Page 49 of Balachander does not constitute ordering features as that step is meant in the claims. The loop hierarchy described in Page 49 of Balachander performs a simple extent-wise classification of the feature loops. This is done for only one orthographic view. **Claim 58 requires that the ordering is done using 2-D geometry of up to six orthographic views in the drawing.** The list of features on pages 54-56 of Balachander does not show any resolution of feature order or dependency. Balachander also does not provide any discussion on "writing the ordered list of three-dimensional features to a binary file format" (item (f) of Claim 58 of our invention). The output data file merely stores the classification of feature and the elementary feature parameters such as length, height and depth and stores no coordinate system information necessary for maintaining an ordered list of the features.

Furthermore, Applicants submit that Hazama is drawn to a process of developing 3-D sheet metal parts from 2-D sheet metal drawings only and is used for identifying manufacturing features. In contrast, Claim 58 as amended is drawn to a method that involves identifying and ordering elements using geometry of **up to six orthographic views** of generic 2-D mechanical drawings to form parametric, design feature-based 3-D models.

2. Balachander does not teach the order resolution of features and cannot teach producing a parametric, feature-based 3-D model as required by Claim 60

With regard to Claim 60, the figure in Balachander referenced by the Examiner (Figure 5.23) on page 55 only depicts the classified form features that have been identified. As already discussed, Balachander does not teach any order resolution of features. Thus, it does not teach producing a parametric, feature-based three dimensional model as required by Claim 60.

3. Balachander does not teach model verification by back projecting the 3-D model and overlaying the drawing views on the 2-D drawing views, as Claims 61-63 require

The Examiner maintains that Claims 61-63 are an obvious variation of views represented in Figure 5.19 of Balachander. Applicants maintain that this is incorrect. Figure 5.19 merely illustrates a sample 2-D drawing to discuss the different types of loops found in a 2-D drawing i.e., base, isolated or non-isolated. It does not discuss or bear relevance to the process of model verification that the claims are meant to serve. These claims refer to the process of projection after the 3-D model has already been created so that the process of 3-D model creation can be verified by looking for differences from the original input 2-D drawing. This step has not been taught anywhere in Balachander's publication.

The Examiner also refers to the text *"We study the 2-D orthographic projections of the 3-D geometric entitiy..."* in Page 18 of Balachander. This introduction discussion refers to the studying the orthographic views in the input 2-D drawing itself. It is true that all input drawings will contain orthographic projections. At the stage of Balachander's discussion, no feature recognition has begun yet and only the input drawing is being studied. However, the step of projection of 3-D model back to 2-D orthographic views in Claims 61-63 refers to a sub-process of the invention performed after the 3-D model has been recognized from the 2-D input drawing, its data has been stored in the binary/intermediate file format, and it has been drawn on to the parent CAD system.

4. Balachander does not teach the automatic splitting of geometric entities required by Claim 65

In the rejection of Claim 65, the figure (Figure 5.19) on Page 47 of Balachander cited by the Examiner actually describes the results of the identification of isolated loops in a 2-D drawing. This is entirely different from Claim 65, which refers to the automatic splitting of geometric entities (lines, arcs, circles etc.) in the corrected 2-D input drawing to form a network of further indivisible entities. Lacking the teaching of this initial claim limitation, the citation of Hazama is not sufficient to render Claim 65 obvious in combination with Balachander.

5. Balachander does not teach fixing a common origin, nor translating the entities, as required by Claims 66-68

With regard to the rejections of Claims 66-68, the text on page 26 of Balachander cited by the Examiner differs from that in the claims because the center points for arcs and circles are not included in the normalization, whereas the translation of the arcs and circles in the claim would take care of the center points as well. Also, since the implementation of the process in Balachander was done in C, it differs from the use of object-oriented class data structures used in the current claims. The term "translational" used in classifying the identified features on page 56 of Balachander refers to the type of feature (translational or rotational, etc.). It differs from the claim term used in Claims 67 and 68, where the geometric entities are shifted (translated) based on the common origin fixed in Claim 66.

6. Balachander does not teach correcting a 2-D drawing prior to its use in feature extraction, as the steps in Claim 71 are performed

In the rejection of Claim 71, Balachander does not provide any teachings on any corrections done to a 2-D drawing prior to their use in feature extraction and therefore does not teach the sub-steps performed in step (c) in Claim 71. The sub-steps in step (c) occur prior to the occurrence of step (d) of Claim 58. Also, the term "subpart" in Claim 71 refers to an independently identifiable 3-D join feature and cannot be compared to a simple generic shape like a cone, as discussed on page 19 of Balachander. Furthermore, the terms subpart extraction and matching refer to the process of traversals through the orthographic views in the corrected input 2-D drawing to extract the subparts

and then, to match the extents of the subparts in one view along subparts or combinations thereof from other orthographic views. These two sub-steps of the claim are not taught or suggested by any extraction procedure discussed in Balachander. Finally, the term "nested loops" in Claim 71 refers to any internal feature loop that may be isolated or shares a border (non-isolated) with the outer parent feature loop. The term differs in scope from that used in Balachander because identification of non-isolated feature loops was not been discussed at all by Balachander due to their greater complexity.

7. Balachander does not teach the profile analysis performed in the sub-steps of Claim 72

Finally, with regard to Claim 72, the section of text on Page 46 of Balachander has no relevance to Claim 72. This section discusses a strategy for simpler representation of feature loops containing circular segments. The sub-part extraction and profile analysis performed in Claim 72 is simply not taught by the references to "breaking down individual parts of the model – cone" on Page 19 and "classifying circular features and replacing them with simplified features i.e. squares" on Page 46 of Balachander. The term "profile analysis on each loop match" used in Claim 72 refers to the geometric test on each feature loop to determine the most likely type of feature (extrusion, revolve, fillet, chamfer, hole etc.) and the volume operation. Balachander merely discusses the geometric analysis of self-standing generic shapes in the first part. It does not teach extracting subparts of a 2D drawing that could interact with other subparts in different orthographic views of the input drawing. The discussion in Page 46 of Balachander deals with representing circular features whereas the process of profile analysis in the applicant's invention investigates into the loops identified thus far determining the nature of feature that the loops would form such as extrusion, revolve, hole, chamfer, fillet etc. and their volume operation. Balachander discusses merely the classification of form features identified and the elementary parameters. Since no feature ordering information is stored in the process described in Balachander, it is not appropriate to apply it to the process of "building feature subtrees," "building feature relations on the subtrees," "building a model tree based on the relations," and "producing a final feature tree...ordered list of three dimensional features" as defined in Claim 72. Again, Figure 2.1 on Page 9 of Balachander merely refers to the classification list of form features widely available in mechanical CAD literature back in

1994 and bears no relevance to the tree/subtree terminology used in Claim 72 to describe the process of storing and building the final 3-D model.

Applicants respectfully assert that Claims 58-63, 65-68, and 71-72 are patentably distinct from Balachander in view of Hazama. These references do not teach feature ordering through the use of multiple orthographic views of the features, which Claim 58 requires. Furthermore, these references fail to teach numerous other claim limitations, as discussed above. Thus, Balachander in view of Hazama do not render Claims 58-63, 65-68, and 71-72 obvious.

VI. Conclusion

Applicants respectfully submit that, in light of the foregoing comments, Claims 1, 6-13, 19-22, 24, 26, 28, 58-63, 64-68, 71, and 72 are in condition for allowance. A Notice of Allowance is therefore requested.

If the Examiner has any other matters which pertain to this Application, the Examiner is encouraged to contact the undersigned to resolve these matters by Examiner's Amendment where possible.

Respectfully submitted,

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